

# Lecture Module - Steady State Circuits

Mechanical Engineering  
Tennessee Technological University

## Topic 2 - Fundamental Laws

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- Ohm's Law
- Combining Resistance
- Kirchhoff's Laws
- Power Dissipation

# Ohm's Law

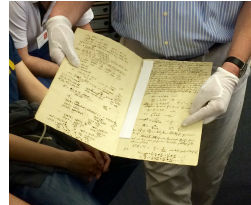
**James Maxwell**



**George Ohm**



**Ohm's Notebook**



Ohm did his work on resistance in the years 1825 and 1826, and published his results in 1827 as the book *Die galvanische Kette, mathematisch bearbeitet*...

# Ohm's Law

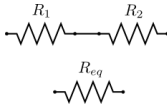
Ohm's law states that the current through a conductor between two points is directly proportional to the voltage across the two points.

It is more commonly shown in the following form.

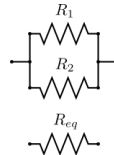


# Combining Resistance

## Resistors in Series



## Resistors in Parallel



# Kirchhoff's Laws

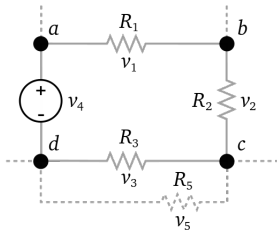
Both of Kirchhoff's laws can be understood as corollaries of Maxwell's equations in the low-frequency limit. They are accurate for DC circuits, and for AC circuits at frequencies where the wavelengths of electromagnetic radiation are very large compared to the circuits.

- 1 Kirchhoff's Voltage Law (KVL)
- 2 Kirchhoff's Current Law (KCL)

# Kirchhoff's Laws

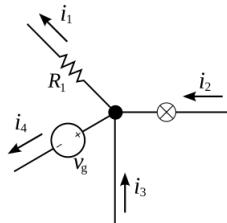
## Kirchhoff's Voltage Law (KVL) -

The sum of the voltages around a loop (aka mesh) equals zero.



## Kirchhoff's Current Law (KCL) -

The sum of the current flowing in and out of node (aka junction) equals zero.



# Power Dissipation

Energy is transformed in to heat in passive circuit components. For a resistor the power dissipation can be found with following relations.



# Power Dissipation

Power is the rate of energy dissipated, aka the amount of energy lost per unit of time. How do we compute total energy for the power?